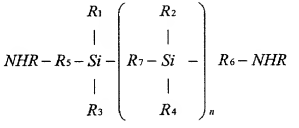
Claims

1. A polyurethane-urea elastomeric composition which is derived from a silicon-containing diamine of the formula (I):



(I)

wherein

R is hydrogen or an optionally substituted straight chain, branched or cyclic, saturated or unsaturated hydrocarbon radical;

R_1, R_2, R_3, R_4, R_5 and R_6 are the same or different and selected from hydrogen or an optionally substituted straight chain, branched or cyclic, saturated or unsaturated hydrocarbon radical;

R_7 is a divalent linking group or an optionally substituted straight chain, branched or cyclic, saturated or unsaturated hydrocarbon radical; and

n is an integer of 1 or greater.

2. A polyurethane-urea elastomeric composition according to claim 1 wherein the diamine of the formula (I) functions as chain extender when n is 1 to 4 for molecular weights of about 500 or less.

3. A polyurethane-urea elastomeric composition according to claim 1 wherein the diamine of the formula (I) functions as a macrodiamine to form the soft segment of a polyurethane-urea composition when n is 5 to 100 for molecular weights of about 500 to about 10,000.

4. A polyurethane-urea elastomeric composition according to any one of claims 1 to 3 wherein the diamine of the formula (I) is used in combination with other chain extenders, macrodiols and/or macrodiamines.

5. Use of the diamine of the formula (I) defined in claim 1 in producing a polyurethane-urea elastomeric composition.

6. The diamine of the formula (I) defined in claim 1 when used in producing a polyurethane-urea elastomeric composition.

7. A chain extender including the diamine of the formula (I) defined in claim 1.

8. A chain extender according to claim 7 wherein the diamine of formula (I) has a molecular weight range of about 60 to about 500.

9. A chain extender according to claim 7 or claim 8 wherein the diamine of formula (I) has a molecular weight range of about 60 to about 450.

10. A chain extender according to any one of in claims 7 to 9 wherein the diamine of the formula (I) is 1,3-bis(3-aminopropyl) tetramethyldisiloxane (R_1, R_2, R_3, R_4 are methyl, R_5 and R_6 are propyl and R_7 is O) or 1,3-bis(4-aminobutyl) tetramethyldisiloxane (R_1, R_2, R_3, R_4 are methyl, R_5 and R_6 are butyl and R_7 is O).

11. A chain extender according to any one of claims 7 to 10 wherein the diamine of the formula (I) is combined with a chain extender known in the art of polyurethane manufacture.

12. A chain extender according to claim 11 wherein the chain extender known in the art of polyurethane manufacture is a diol, diamine or water chain extender.

13. A chain extender according to claim 12 wherein the diol chain extender is 1,4-butanediol, 1,6-hexanediol, 1,8-octanediol, 1,9-nonanediol, 1,10-decanediol, 1,12-dodecanediol, 1,4-cyclohexanedimethanol, p-xyleneglycol, 1,4 bis(2-hydroxyethoxy) benzene or water.

14. A chain extender according to claim 12 wherein the diamine chain extender is 1,2-ethylenediamine, 1,3-propanediamine, 1,3-butanediamine, 1,6-hexanediamine., 1,2-diaminocyclohexane, 1,3-diaminocycloexane.

15. A chain extender according to any one of claims 11 to 14 wherein the molar percentage of diamine chain extender is about 1 to about 50 %.

16. A chain extender according to any one of claims 11 to 15 wherein the molar percentage of diamine chain extender is about 40%.

17. Use of the diamine of the formula (I) defined in claim 1 as a chain extender.

18. The diamine of the formula (I) defined in claim 1 when used as a chain extender.

19. A soft segment of a polyurethane-urea elastomeric composition derived from the diamine of the formula (I) defined in claim 1.

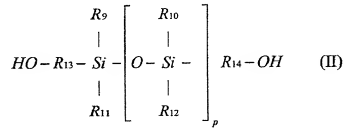
20. A soft segment of a polyurethane-urea composition according to claim 19 wherein the diamine of the formula (I) is an amine-terminated PDMS.

21. A soft segment of a polyurethane-urea composition according to claim 20 wherein the amine-terminated PDMS is bis(3-hydroxypropyl)-polydimethyl siloxane.

22. A soft segment of a polyurethane-urea composition according to claims 19 to 21 wherein the diamine of formula (I) is combined with a macrodiol and/or macrodiamine known in the art of polyurethane manufacture.

23. A soft segment of a polyurethane-urea composition according to claim 22 wherein the macrodiol is a polysiloxane, polyether, polyester, polycarbonate or mixtures thereof.

24. A soft segment of a polyurethane-urea composition wherein the polysiloxane macrodiol is hydroxy terminated and represented by the formula (II)



(II)

wherein

R_9, R_{10}, R_{11}, R_{12}, R_{13} and R_{14} are same or different and selected from an optionally substituted straight chain, branched or cyclic, saturated or unsaturated hydrocarbon radical; and

p is an integer of 1 to 100.

25. A soft segment of a polyurethane-urea composition according to claim 24 wherein the polysiloxane macrodiol is PDMS (compound of formula (II) wherein R_9 to R_{12} are methyl and R_{13} and R_{14} are as defined in claim 24).

26. A soft segment of a polyurethane-urea composition according to claim 25 wherein R_{13} and R_{14} are the same or different and selected from propylene, butylene, pentylene, hexylene, ethoxypropyl ($-CH_2CH_2OCH_2CH_2CH_2-$), propoxypropyl or butoxypropyl.

27. A soft segment of a polyurethane-urea composition according to any one of claims 23 to 26 wherein the molecular weight range of the polysiloxane macrodiol is about 200 to about 6000.

28. A soft segment of a polyurethane-urea composition according to claim 27 wherein the molecular weight range of the polysiloxane macrodiol is about 500 to about 2000.

29. A soft segment of a polyurethane-urea composition according to any one of claims 22 to 28 which is derived from amine-terminated PDMS and PDMS.

30. A soft segment of a polyurethane-urea composition according to claim 23 wherein the polyether macrodiol is represented by the formula (III)

$$HO-[(CH_2)_q-O]_r-H \qquad \text{(III)}$$

wherein

q is an integer of 4 or more; and

r is an integer of 2 to 50.

31. A soft segment defined in claim 30 wherein the polyether macrodiol of formula (III) has q is 5 or higher.

32. A soft segment defined in claim 31 wherein the polyether macrodiol is poly(hexamethylene oxide) (PHMO), poly(heptamethylene oxide), poly(octamethylene oxide) (POMO) or poly(decamethylene oxide) (PDMO).

33. A soft segment of a polyurethane-urea composition according to any one of claims 30 to 32 derived from a macrodiamine of the formula (I) defined in claim 1 and a polyether macrodiol of formula (III) defined in claim 30.

34. A soft segment of a polyurethane-urea composition according to claims 23 to 33 wherein the molecular weight range of the polyether macrodiol is about 200 to about 5000.

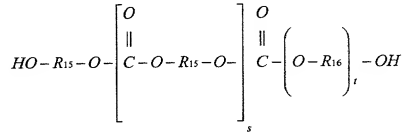
35. A soft segment defined in claim 34 wherein the molecular weight range of the polyether macrodiol is about 500 to about 1200.

36. A soft segment of a polyurethane-urea composition according to any one of claims 23 to 35 wherein the polycarbonate macrodiol is a poly(alkylene carbonate), polycarbonates prepared by reacting alkylene carbonate with alkanediols or silicon

based polycarbonates prepared by reacting alkylene carbonate with 1,3-bis(4-hydroxybutyl)-1,1,3,3-tetramethyldisiloxane (BHTD) and/or alkanediols.

37. A soft segment of a polyurethane-urea composition according to any one of claims 23 to 36 wherein both the polyether and polycarbonate macrodiols are present and are in the form of a mixture or a copolymer.

38. A soft segment of a polyurethane-urea composition according to claim 37 wherein the copolymer is a copoly(ether carbonate) macrodiol represented by the formula (IV)



(IV)

wherein

R_{15} and R_{16} are same or different and selected from an optionally substituted straight chain, branched or cyclic, saturated or unsaturated hydrocarbon radical; and s and t are integers of 1 to 20.

39. A soft segment of a polyurethane-urea composition according to any one of claims 22 to 38 wherein the macrodiamine known in the art of polyurethane manufacture is a polyether macrodiamine.

40. A soft segment of a polyurethane-urea composition according to claim 39 wherein the polyether macrodiamine is POLAMINE 650 which is an amino-terminated poly(tetramethylene oxide).

41. Use of the diamine of the formula (I) defined in claim 1 in producing the soft segment of a polyurethane-urea elastomeric composition.

42. The diamine of the formula (I) defined in claim 1 when used in producing the soft segment of a polyurethane-urea elastomeric composition.

43. A polyurethane-urea elastomeric composition which is derived from a polysiloxane macrodiol and a polyether macrodiol and/or a polycarbonate macrodiol and a diamine chain extender known in the art of polyurethane manufacture.

44. A polyurethane-urea elastomeric composition including a reaction product of:

(i) the macrodiamine of the formula (I) defined in claim 1 and/or a macrodiol;

(ii) a diisocyanate; and

(iii) a diamine chain extender or chain extender composition defined in any one of claims 7 to 16 and/or a chain extender known in the art of polyurethane manufacture.

45. A polyurethane-urea elastomeric composition according to claim 44 wherein the diisocyanate is aliphatic or aromatic

46. A polyurethane-urea elastomeric composition according to claim 44 or 45 wherein the diisocyanate is 4,4'-diphenylmethane diisocyanate (MDI), methylene bis (cyclohexyl) diisocyanate (H_{12}MDI), p-phenylene diisocyanate (p-PDI), trans-cyclohexane-1,4-diisocyanate (CHDI), 1,6-diisocyanatohexane (DICH), 1,5-diisocyanato naphthalene (NDI), *para*-tetramethylxylene diisocyanate (p-TMXDI), *meta*-tetramethylxylene diisocyanate (m-TMXDI), 2,4-toluene diisocyanate (2,4-TDI) or isophorone diisocyanate (IPDI) or isomers or mixtures thereof.

47. A polyurethane-urea elastomeric composition according to any one of claims 44 to 46 including a reaction product of:

(i) macrodiols including:

polysiloxane macrodiol; and

polyether macrodiol

(ii) MDI ; and

(iii) a diamine chain extender as defined in any one of claims 7 to 10 or known in the art of polyurethane manufacture or a chain extender composition including a diamine chain extender and 1,3-bis(3-aminopropyl) tetramethyldisiloxane, 1,3-bis(4-aminobutyl) tetramethyldisiloxane, 1,4-butanediol, 1,2-ethylenediamine, ethanolamine, hexamethylenediamine, 1,4-butanediamine, water and/or 1,4-bis(4-hydroxybutyl) tetramethyldisiloxane.

48. A polyurethane-urea elastomeric composition according to claim 47 wherein the weight ratio of polysiloxane macrodiol to polyether macrodiol in the composition is in the range of 1:99 to 99:1.

49. A polyurethane-urea elastomeric composition according to claim 47 or claim 48 wherein the weight ratio of polysiloxane to polyether is 80:20.

50. A polyurethane-urea elastomeric composition according to any one of claims 44 to 49 wherein the weight level of soft segment (weight percentage of the macrodiol mixture in the polyurethane-urea composition) is about 60 to about 40 wt %.

51. A polyurethane-urea elastomeric composition which includes a reaction product of:

(i) macrodiamines including
polysiloxane macrodiamine; and
polyether macrodiol or polyether macrodiamine;

(ii) MDI ; and

(iii) a diamine chain extender, a chain extender known in the art of polyurethane manufacture or a chain extender composition including at least two of 1,3-bis(3-aminopropyl) tetramethyldisiloxane, 1,3-bis(4-aminobutyl) tetramethyldisiloxane, 1,4-butanediol, 1,2-ethylenediamine, ethanolamine, hexamethylenediamine, 1,3-diaminocyclohexane, 1,2—diamino cyclohexane, water or 1,3-bis(4-hydroxybutyl) 1,1,3,3- tetramethyldisiloxane.

52. A polyurethane-urea elastomeric composition according to claim 5 wherein the level of hard segment (diisocyanate and chain extender) in the composition is about 15 to 50 wt %.

53. A polysiloxane polyurethane-urea elastomer composition including a reaction product of:

(i) macrodiol selected from the group consisting of polysiloxane macrodiols, polyether macrodiols, polycarbonate macrodiols and mixtures thereof.

(ii) MDI; and

(iii) a chain extender selected from diamines, diols and water.

54. A material having improved mechanical properties, clarity, processability and/or degradation resistance including the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

55. A material resistant to cyclic flex fatigue which includes the polyurethane-urea composition defined in any one of claims 1 to 4 and 43 – 55.

56. A degradation resistant material which includes the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

57. An *in vivo* degradation resistant material which includes the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

58. A biomaterial which includes the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

59. Medical devices, articles or implants which are composed wholly or partly of the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

60. Medical devices, articles or implants according to claim 59 which are cardiac pacemakers, defibrillators and other electromedical devices, catheters, cannulas, implantable prostheses, cardiac assist devices, heart valves, vein valves, vascular grafts, extra-corporeal devices, artificial organs, pacemaker leads, defibrillator leads, blood pumps, balloon pumps, A-V shunts, biosensors, membranes for cell encapsulation, drug delivery devices, wound dressings, artificial joints, orthopaedic implants and soft tissue replacements.

61. Devices or articles which are composed wholly or partly of the polyurethane-urea elastomeric composition defined in any one of claims 1 to 4 and 43 to 53.

62. Devices or articles according to claim 61 which are artificial leather, shoe soles; cable sheathing; varnishes and coatings; structural components for pumps, vehicles, etc; mining ore screens and conveyor belts; laminating compounds, textiles; separation membranes; sealants or components of adhesives.